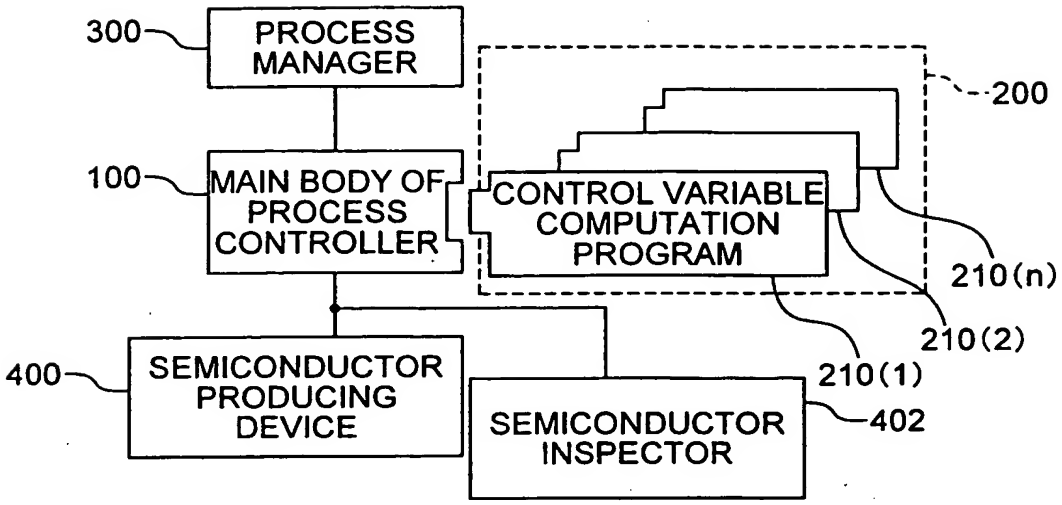

300
PROCESS MANAGER
100
MAIN BODY OF PROCESS CONTROLLER
CONTROL VARIABLE COMPUTATION PROGRAM
200
210(n)
210(2)
210(1)
400
SEMICONDUCTOR PRODUCING DEVICE
SEMICONDUCTOR INSPECTOR
402

FIG. 1A

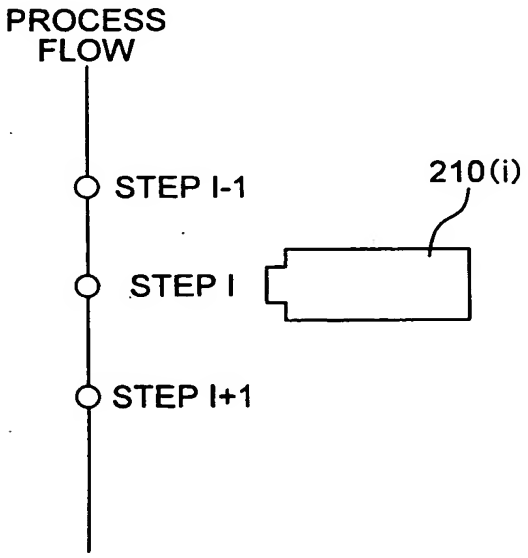

PROCESS FLOW
STEP I-1
STEP I
STEP I+1
210(i)

FIG. 1B

```
CONTROL VARIABLE
COMPUTATION PROGRAM: α  (OX001/AAA)
//ACQUIRE "PROCESSING TIME" AS PROCESS
MANAGING INFORMATION AND SUBSTITUTE IT FOR TEMP
TEMP=GET(PROCESSING TIME);

//SET THE VALUE OF TEMP FOR CONTROL VARIABLE
"TIME",AND TRANSFER IT TO THE APPARATUS
SEND (TIME ,TEMP);
```

FIG. 2

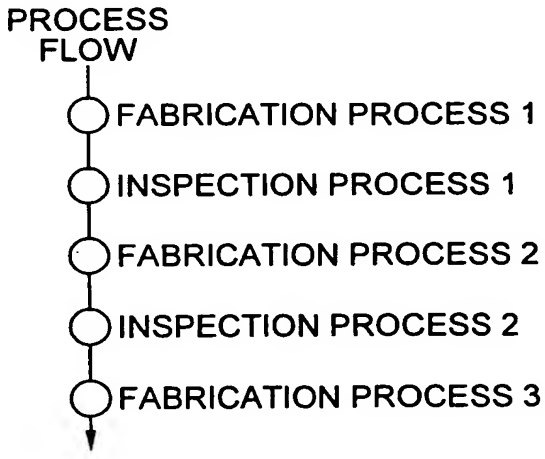


FIG. 3

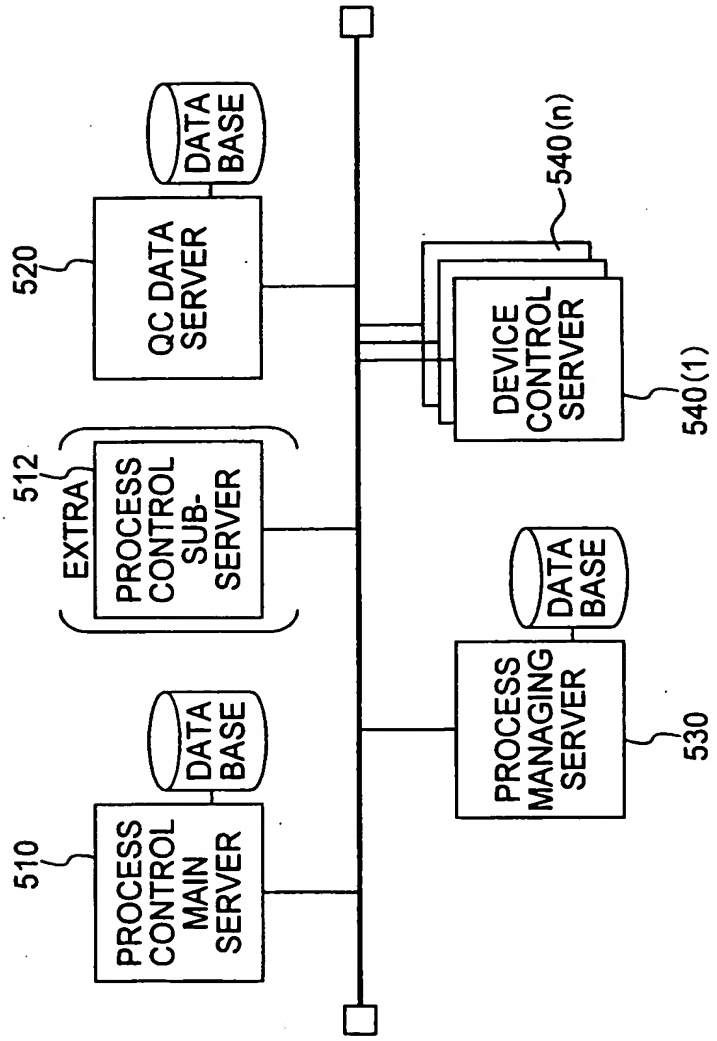

DATA BASE
520
QC DATA SERVER
540(n)
DEVICE CONTROL SERVER
540(1)
512
EXTRA
PROCESS CONTROL SUB-SERVER
DATA BASE
PROCESS MANAGING SERVER
530
DATA BASE
510
PROCESS CONTROL MAIN SERVER

FIG. 4

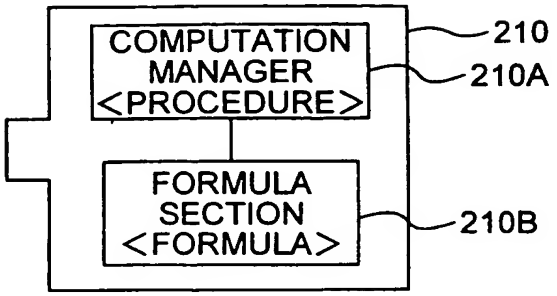


FIG. 5A

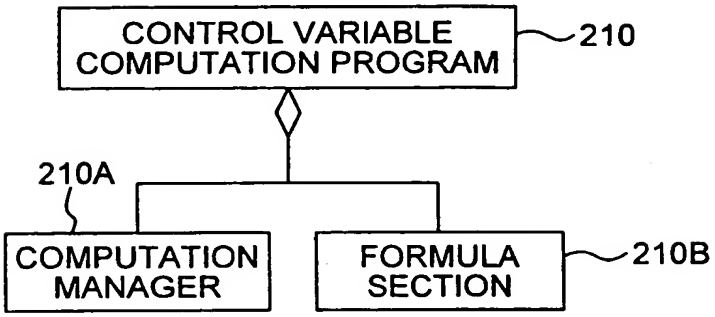


FIG. 5B

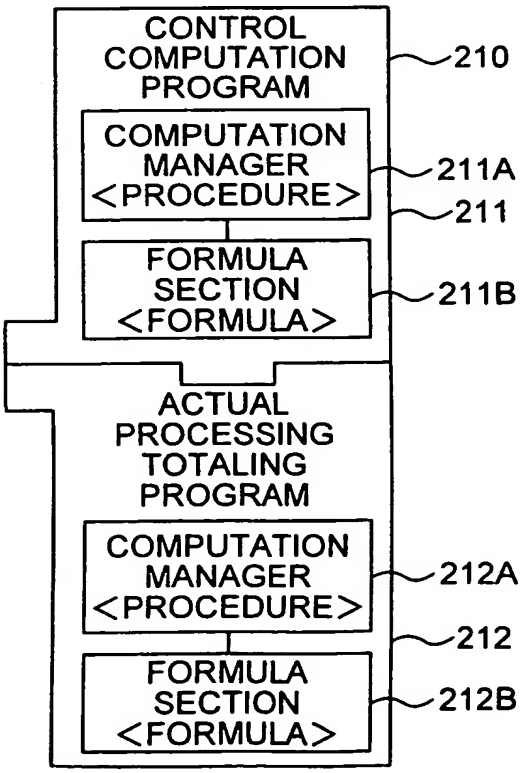


FIG. 6

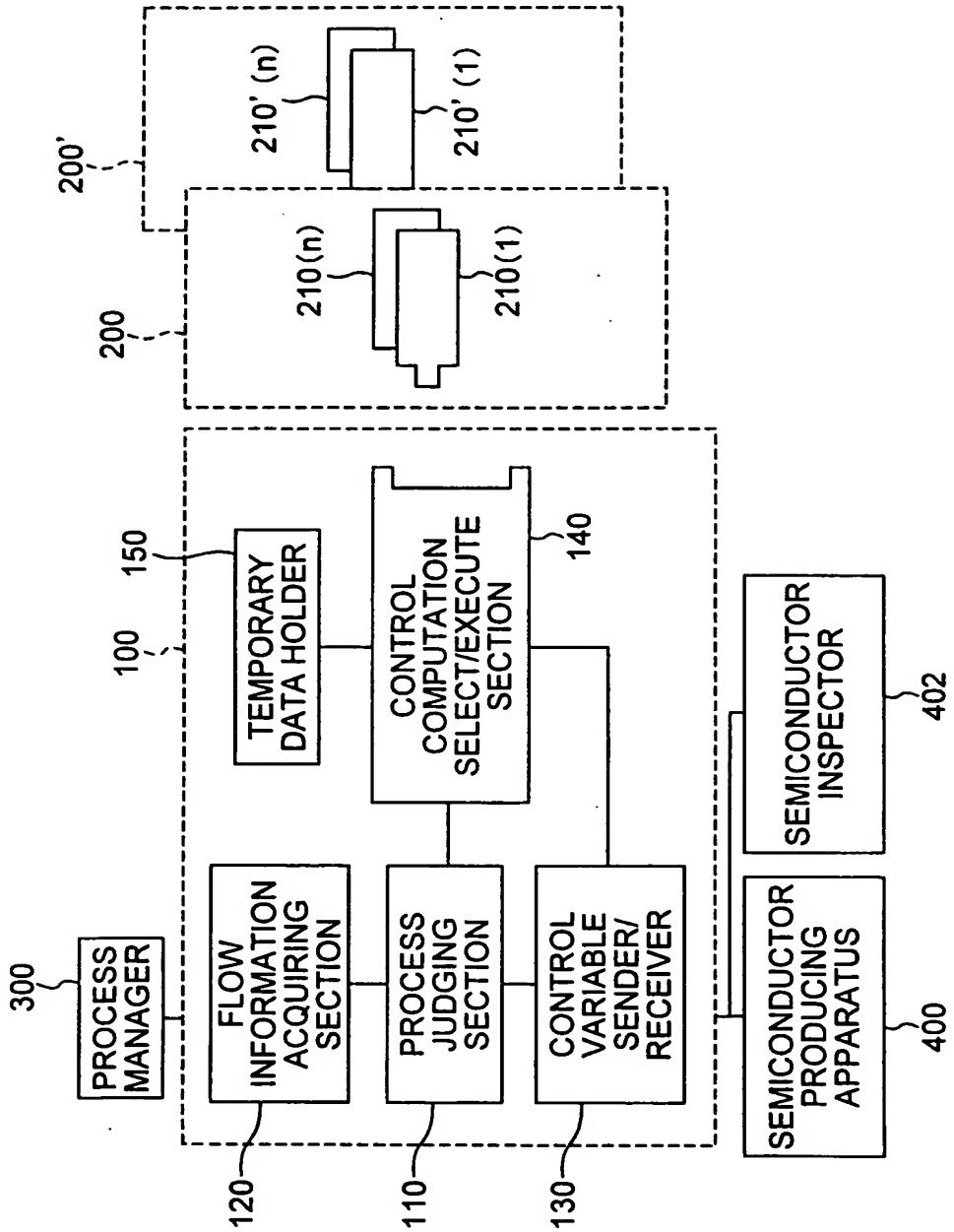

200'
210' (n)
210' (1)
200
210(n)
210(1)
100
150
TEMPORARY DATA HOLDER
CONTROL COMPUTATION SELECT/EXECUTE SECTION
140
300
PROCESS MANAGER
FLOW INFORMATION ACQUIRING SECTION
PROCESS JUDGING SECTION
CONTROL VARIABLE SENDER/ RECEIVER
120
110
130
SEMICONDUCTOR INSPECTOR
402
SEMICONDUCTOR PRODUCING APPARATUS
400

FIG. 7

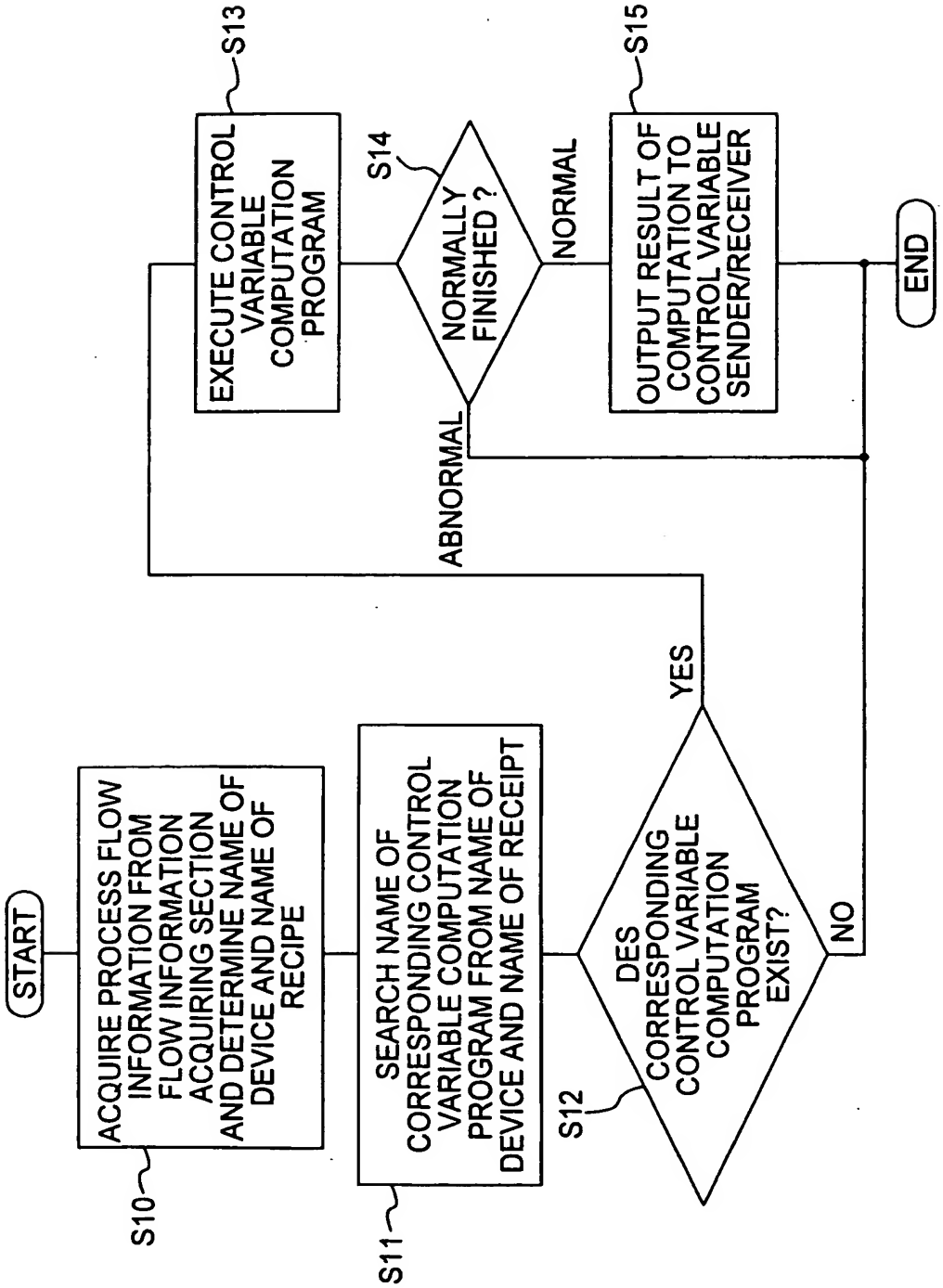

START
ACQUIRE PROCESS FLOW INFORMATION FROM FLOW INFORMATION ACQUIRING SECTION AND DETERMINE NAME OF DEVICE AND NAME OF RECIPE
S10
SEARCH NAME OF CORRESPONDING CONTROL VARIABLE COMPUTATION PROGRAM FROM NAME OF DEVICE AND NAME OF RECEIPT
S11
DES CORRESPONDING CONTROL VARIABLE COMPUTATION PROGRAM EXIST?
S12
YES
NO
EXECUTE CONTROL VARIABLE COMPUTATION PROGRAM
S13
NORMALLY FINISHED ?
S14
NORMAL
ABNORMAL
OUTPUT RESULT OF COMPUTATION TO CONTROL VARIABLE SENDER/RECEIVER
S15
END

FIG. 8

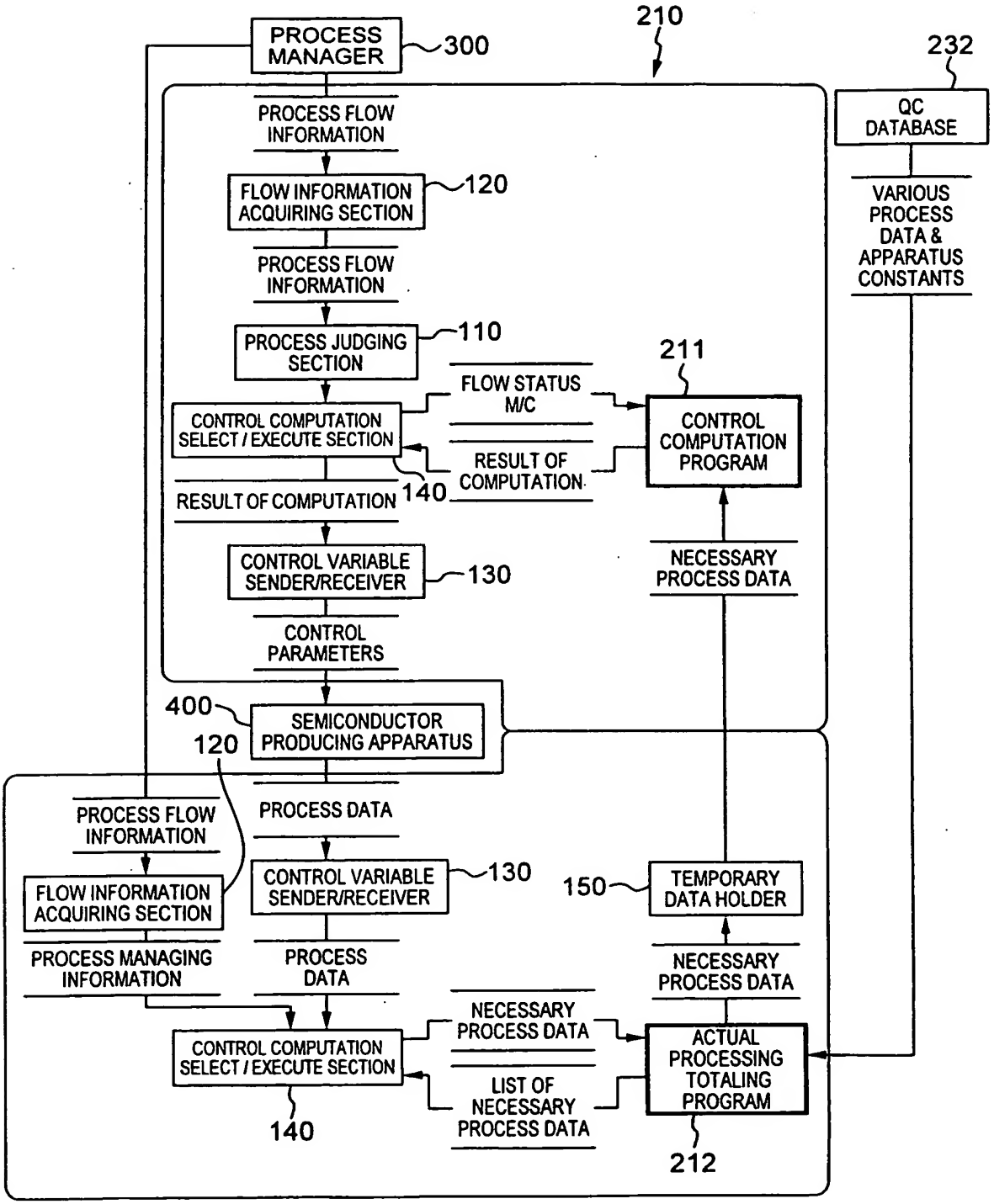

PROCESS MANAGER
300
210
232
QC DATABASE
PROCESS FLOW INFORMATION
FLOW INFORMATION ACQUIRING SECTION
120
VARIOUS PROCESS DATA & APPARATUS CONSTANTS
PROCESS FLOW INFORMATION
PROCESS JUDGING SECTION
110
211
FLOW STATUS M/C
CONTROL COMPUTATION SELECT / EXECUTE SECTION
CONTROL COMPUTATION PROGRAM
RESULT OF COMPUTATION
140
RESULT OF COMPUTATION
CONTROL VARIABLE SENDER/RECEIVER
130
NECESSARY PROCESS DATA
CONTROL PARAMETERS
400
SEMICONDUCTOR PRODUCING APPARATUS
120
PROCESS FLOW INFORMATION
PROCESS DATA
FLOW INFORMATION ACQUIRING SECTION
CONTROL VARIABLE SENDER/RECEIVER
130
150
TEMPORARY DATA HOLDER
PROCESS MANAGING INFORMATION
PROCESS DATA
NECESSARY PROCESS DATA
NECESSARY PROCESS DATA
CONTROL COMPUTATION SELECT / EXECUTE SECTION
ACTUAL PROCESSING TOTALING PROGRAM
LIST OF NECESSARY PROCESS DATA
140
212

FIG. 9

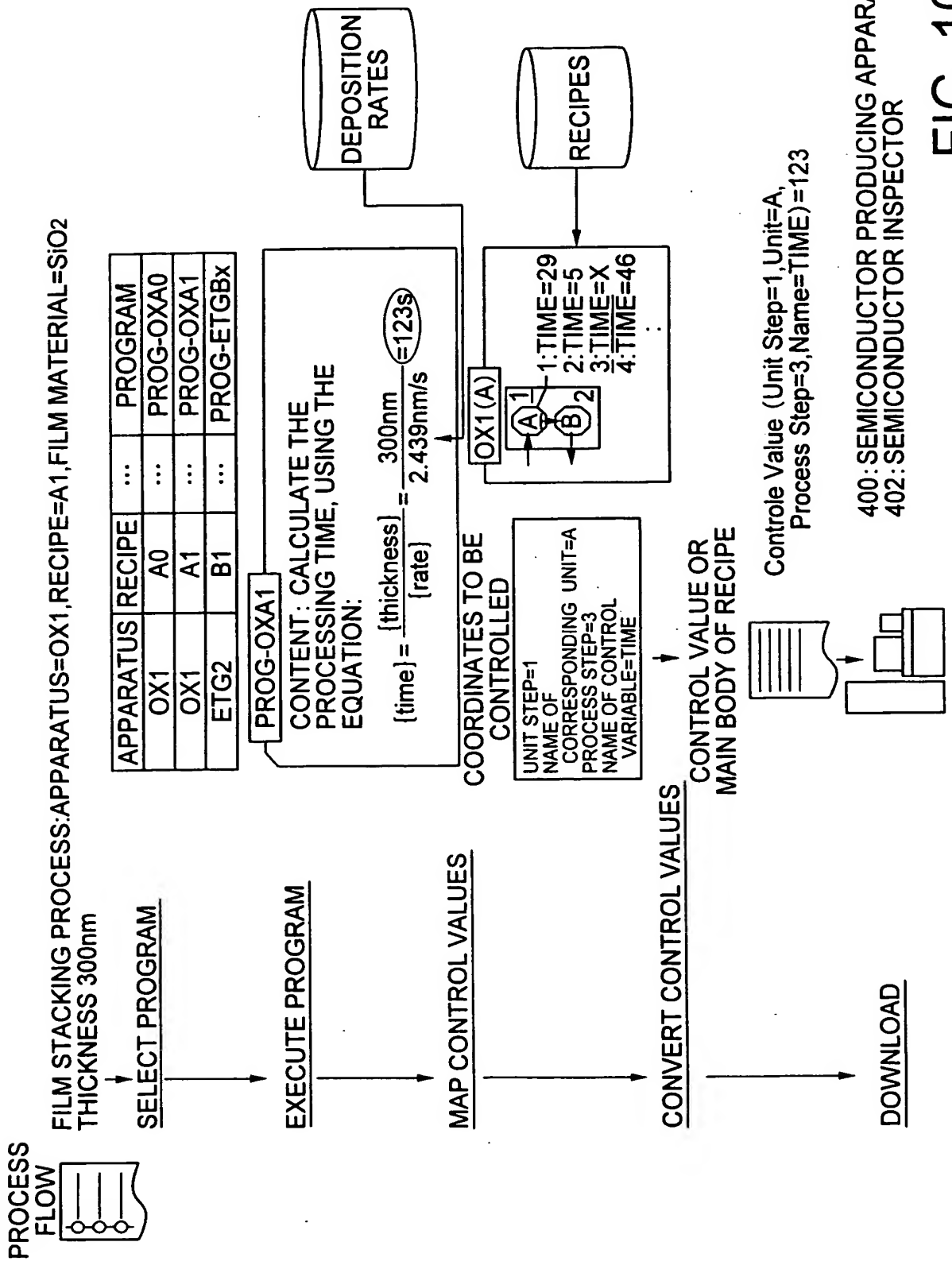

PROCESS FLOW
FILM STACKING PROCESS:APPARATUS=OX1,RECIPE=A1,FILM MATERIAL=SiO2
THICKNESS 300nm
SELECT PROGRAM
EXECUTE PROGRAM
MAP CONTROL VALUES
CONVERT CONTROL VALUES
DOWNLOAD
APPARATUS | RECIPE | ... | PROGRAM
OX1 | A0 | ... | PROG-OXA0
OX1 | A1 | ... | PROG-OXA1
ETG2 | B1 | ... | PROG-ETGBx
PROG-OXA1
CONTENT: CALCULATE THE PROCESSING TIME, USING THE EQUATION:
{time}={thickness}/{rate}=300nm/2.439nm/s (=123s)
COORDINATES TO BE CONTROLLED
UNIT STEP=1
NAME OF CORRESPONDING PROCESS STEP=3
NAME OF CONTROL VARIABLE=TIME
DEPOSITION RATES
RECIPES
OX1(A)
A 1
B 2
1:TIME=29
2:TIME=5
3:TIME=X
4:TIME=46
CONTROL VALUE OR MAIN BODY OF RECIPE
Controle Value (Unit Step=1,Unit=A, Process Step=3,Name=TIME)=123
400:SEMICONDUCTOR PRODUCING APPARATUS
402:SEMICONDUCTOR INSPECTOR

FIG. 10

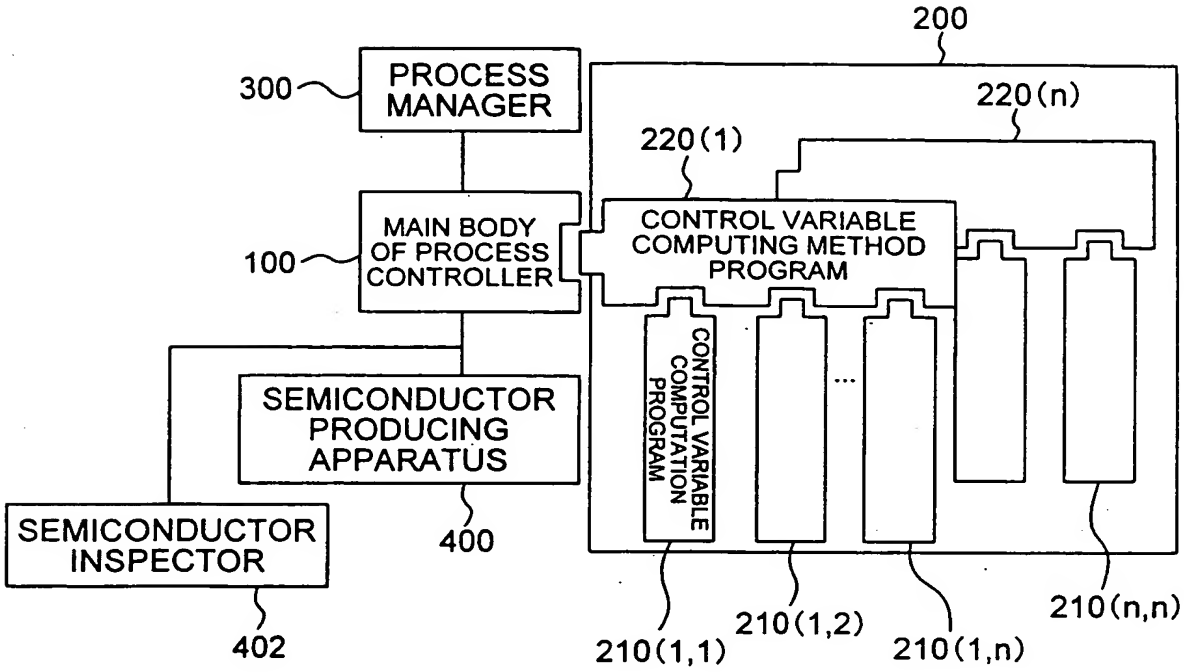


FIG. 11A

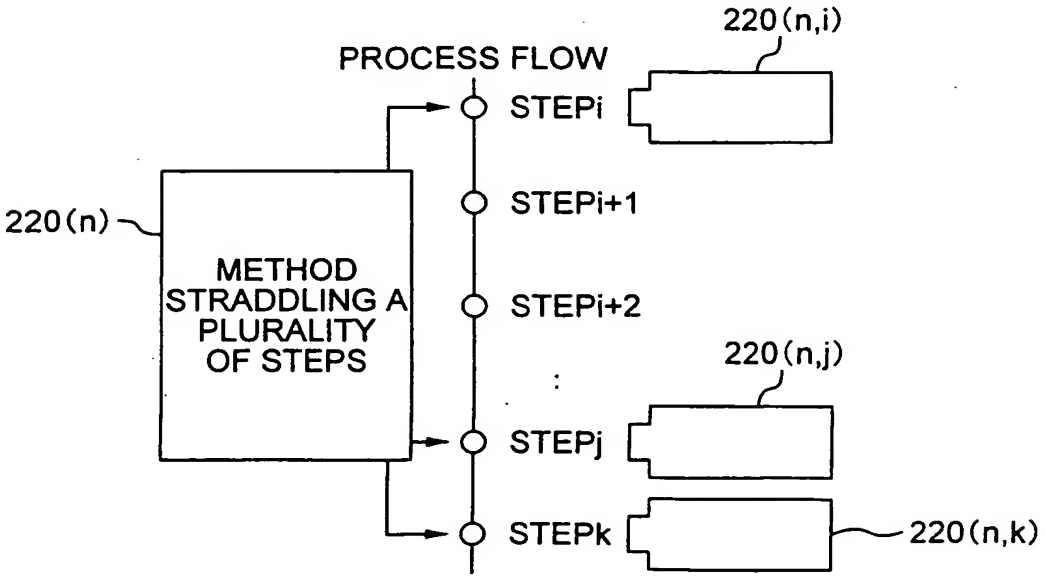


FIG. 11B

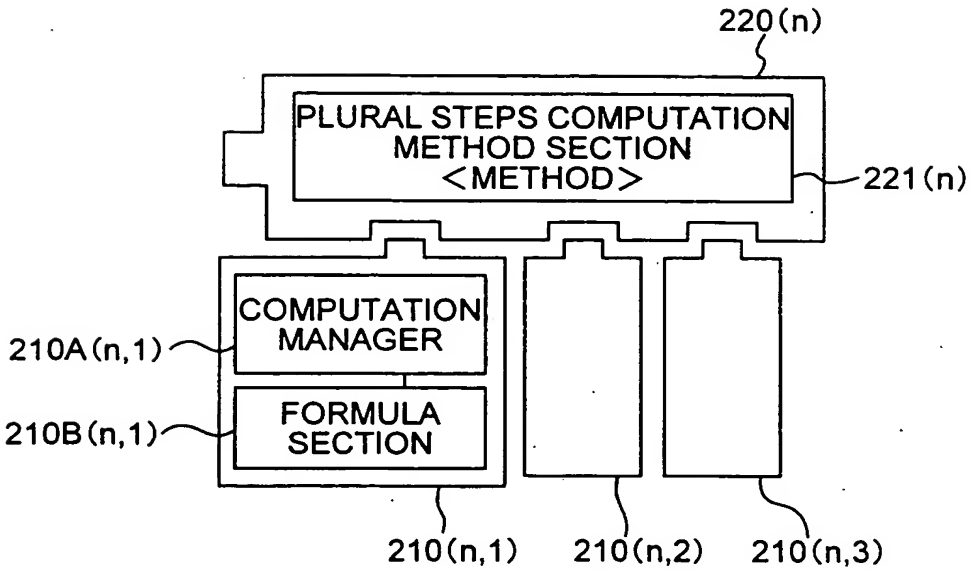


FIG. 12A

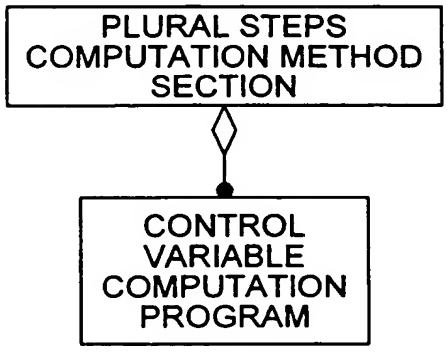
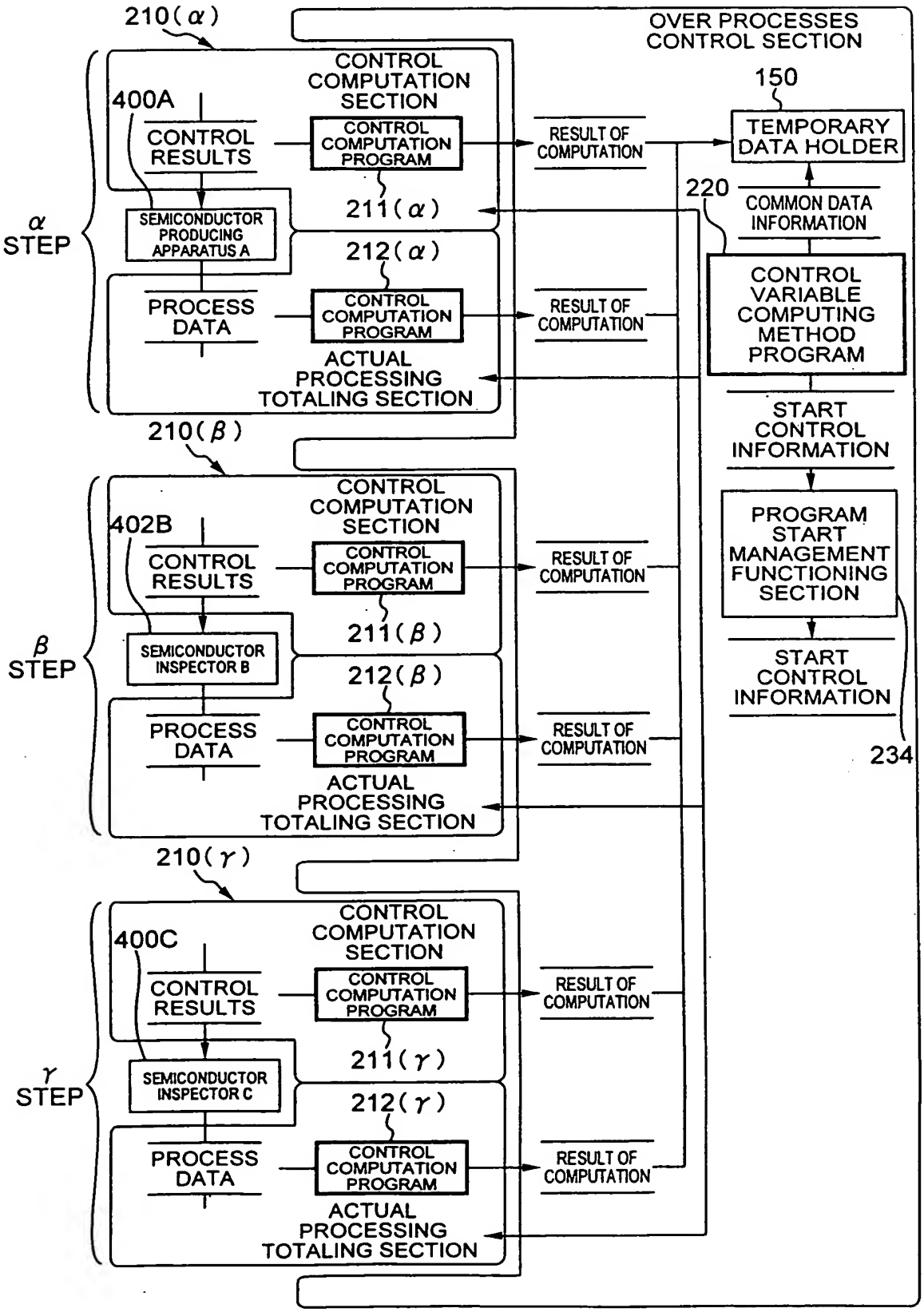
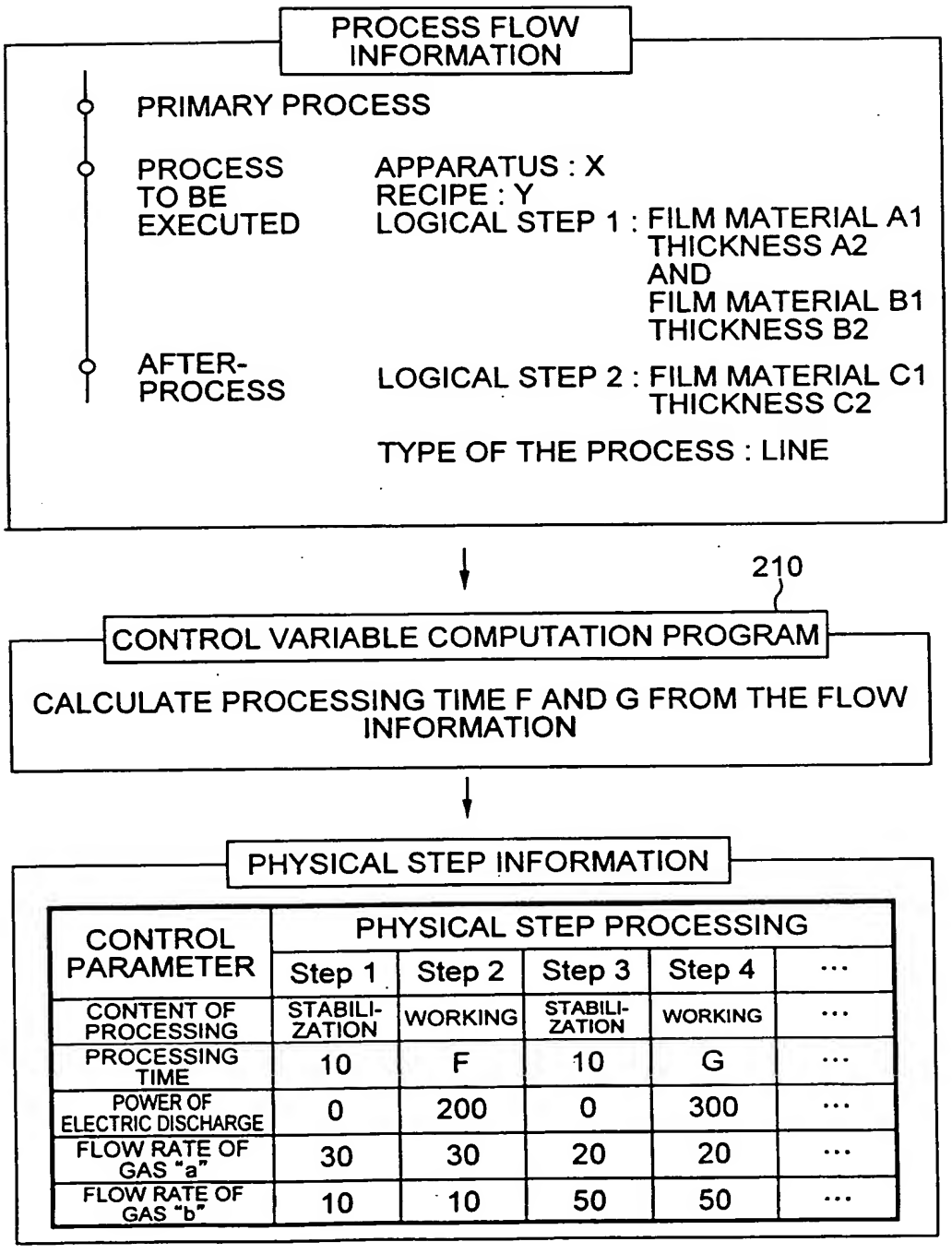


FIG. 12B

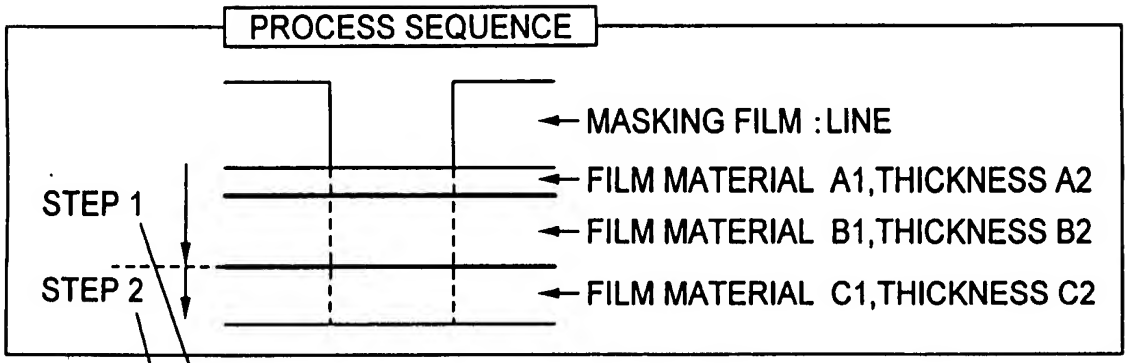
FIG. 13


210(α)
OVER PROCESSES CONTROL SECTION
CONTROL COMPUTATION SECTION
400A
CONTROL RESULTS
CONTROL COMPUTATION PROGRAM
RESULT OF COMPUTATION
150
TEMPORARY DATA HOLDER
220
COMMON DATA INFORMATION
α STEP
SEMICONDUCTOR PRODUCING APPARATUS A
211(α)
212(α)
PROCESS DATA
CONTROL COMPUTATION PROGRAM
RESULT OF COMPUTATION
CONTROL VARIABLE COMPUTING METHOD PROGRAM
ACTUAL PROCESSING TOTALING SECTION
START CONTROL INFORMATION
210(β)
CONTROL COMPUTATION SECTION
402B
CONTROL RESULTS
CONTROL COMPUTATION PROGRAM
RESULT OF COMPUTATION
PROGRAM START MANAGEMENT FUNCTIONING SECTION
β STEP
SEMICONDUCTOR INSPECTOR B
211(β)
212(β)
PROCESS DATA
CONTROL COMPUTATION PROGRAM
RESULT OF COMPUTATION
START CONTROL INFORMATION
234
ACTUAL PROCESSING TOTALING SECTION
210(γ)
CONTROL COMPUTATION SECTION
400C
CONTROL RESULTS
CONTROL COMPUTATION PROGRAM
RESULT OF COMPUTATION
γ STEP
SEMICONDUCTOR INSPECTOR C
211(γ)
212(γ)
PROCESS DATA
CONTROL COMPUTATION PROGRAM
RESULT OF COMPUTATION
ACTUAL PROCESSING TOTALING SECTION



CONTROL PARAMETER	PHYSICAL STEP PROCESSING				
	Step 1	Step 2	Step 3	Step 4	···
CONTENT OF PROCESSING	STABILI-ZATION	WORKING	STABILI-ZATION	WORKING	···
PROCESSING TIME	10	F	10	G	···
POWER OF ELECTRIC DISCHARGE	0	200	0	300	···
FLOW RATE OF GAS "a"	30	30	20	20	···
FLOW RATE OF GAS "b"	10	10	50	50	···

FIG. 14



PROCESSING TIME OF LOGICAL STEP 1 = THICKNESS A2 / PROCESSING RATE (APPARATUS TO BE USED, CONDITION D, FILM MATERIAL A1,LINE) + THICKNESS B2 / PROCESSING RATE (APPARATUS TO BE USED, CONDITION D, FILM MATERIAL B1,LINE) → PROCESSING TIME F

PROCESSING TIME OF LOGICAL STEP 2 = THICKNESS C2 / PROCESSING RATE (APPARATUS TO BE USED, CONDITION D, FILM MATERIAL C1,LINE) → PROCESSING TIME G

LOGICAL/PHYSICAL STEP MANAGING TABLE

CONTROL PARAMETER	PHYSICAL STEP PROCESSING				
	Step 1	Step 2	Step 3	Step 4	···
CONDITION	STABILIZATION	CONDITION D	STABILIZATION	CONDITION E	···
LOGICAL STEP		1		1	···

C-1 TABLE

SEMICONDUCTOR PRODUCING APPARATUS	CONDITION	FILM MATERIAL	STATUS	PROCESSING RATE
APPARATUS TO BE USED	CONDITION D	A1	LINE	1234
APPARATUS TO BE USED	CONDITION D	B1	LINE	2345
APPARATUS TO BE USED	CONDITION E	C1	LINE	2345

FIG. 15

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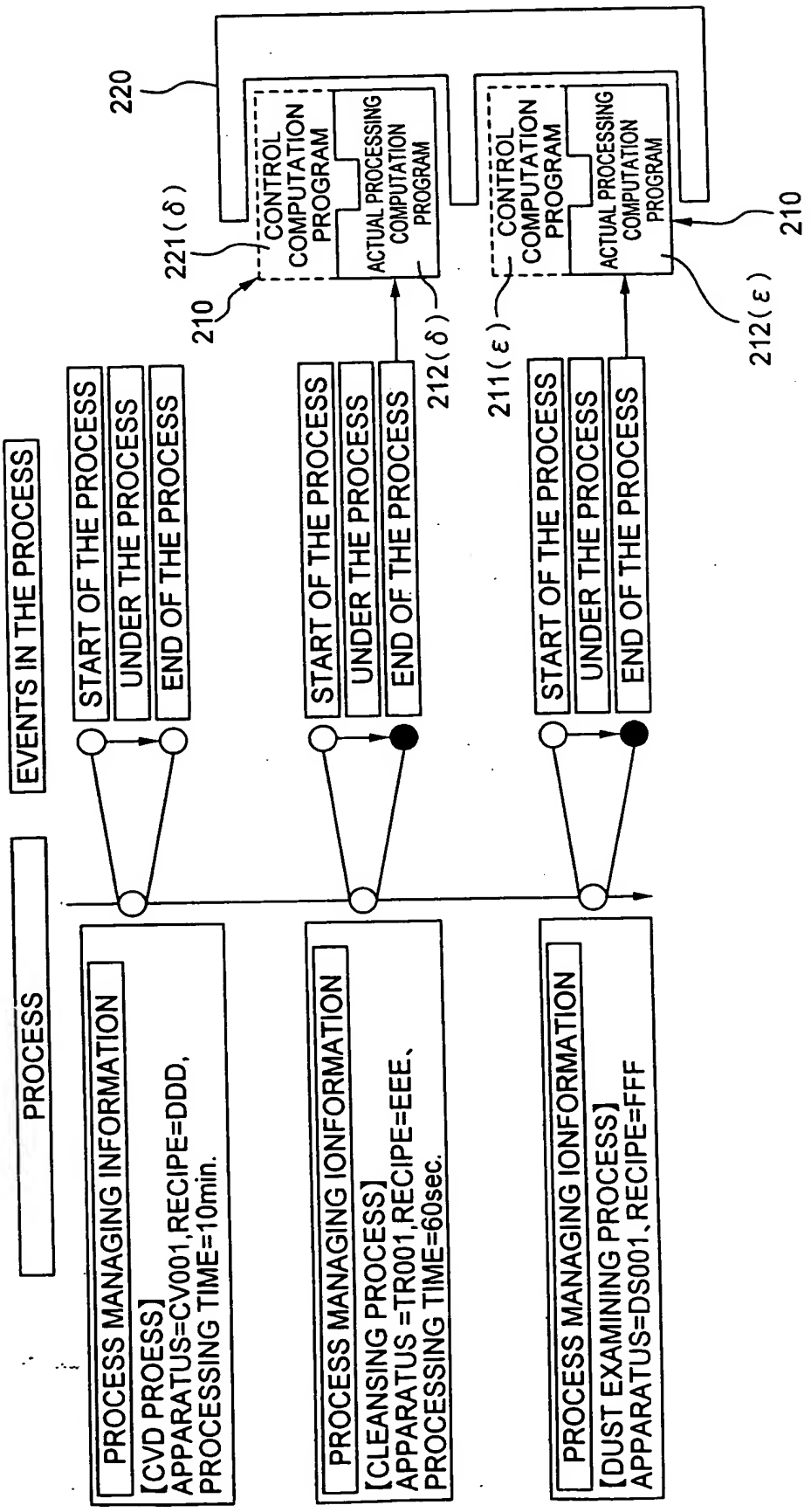

220
CONTROL COMPUTATION PROGRAM
ACTUAL PROCESSING COMPUTATION PROGRAM
221(δ)
210
212(δ)
211(ε)
212(ε)
EVENTS IN THE PROCESS
START OF THE PROCESS
UNDER THE PROCESS
END OF THE PROCESS
PROCESS
PROCESS MANAGING INFORMATION
[CVD PROESS]
APPARATUS=CV001,RECIPE=DDD,
PROCESSING TIME=10min.
PROCESS MANAGING IONFORMATION
[CLEANSING PROCESS]
APPARATUS =TR001,RECIPE=EEE,
PROCESSING TIME=60sec.
PROCESS MANAGING IONFORMATION
[DUST EXAMINING PROCESS]
APPARATUS=DS001,RECIPE=FFF

FIG. 16

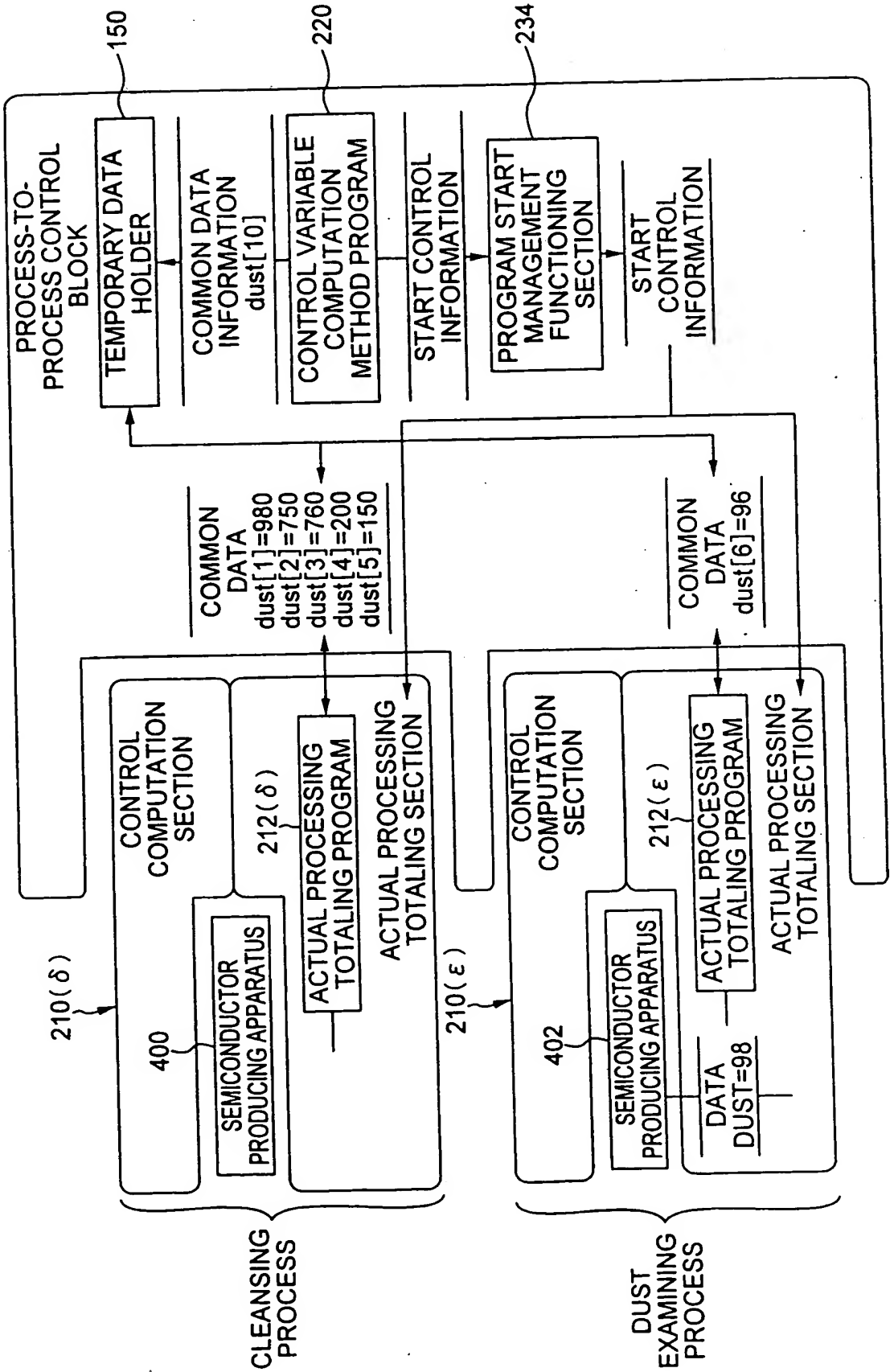

PROCESS-TO-PROCESS CONTROL BLOCK
150
TEMPORARY DATA HOLDER
COMMON DATA INFORMATION dust[10]
220
CONTROL VARIABLE COMPUTATION METHOD PROGRAM
START CONTROL INFORMATION
234
PROGRAM START MANAGEMENT FUNCTIONING SECTION
START CONTROL INFORMATION
COMMON DATA dust[1]=980 dust[2]=750 dust[3]=760 dust[4]=200 dust[5]=150
COMMON DATA dust[6]=96
210(δ)
CONTROL COMPUTATION SECTION
400
SEMICONDUCTOR PRODUCING APPARATUS
212(δ)
ACTUAL PROCESSING TOTALING PROGRAM
ACTUAL PROCESSING TOTALING SECTION
210(ε)
CONTROL COMPUTATION SECTION
402
SEMICONDUCTOR PRODUCING APPARATUS
212(ε)
ACTUAL PROCESSING TOTALING PROGRAM
DATA DUST=98
ACTUAL PROCESSING TOTALING SECTION
CLEANSING PROCESS
DUST EXAMINING PROCESS

FIG. 17

```
ACTUAL PROCESSING TOTALING PROGRAM δ

//READ VALUE INTO ARRAY TEMP [] FROM COMMON DATA
STORAGE REGION "ARRAY []"
COM_SAVE(DUST[],TEMP[]);

//STATISTICALLY JUDGE THE VALUE OF TEMP[] BY EXTERNAL
FUNCTION AND SUBSTITUTE THE RESULT FOR RETURN
return=SPC_JUDGE(temp[]);

//SEND RESULT OF JUDGEMENT TO PROCESS MANAGER TO OMIT
A STEP PM_SEND(return);
```

```
ACTUAL PROCESSING TOTALING PROGRAM ε (DS001/FFF)

//ACQUIRE VALUE OF "DUST " AS PROCESS DATA AND
SUBSTITUTE IT FOR TEMP
TEMP=GET (DUST)

//STORE THE VALUE OF TEMP IN COMMON DATA STORAGE
REGION "DUST[]"
COM_SAVE(dust[].temp);
```

```
PROCESS-TO-PROCESS CONTROL PROGRAM:B

/DEFINE PROGRAM FOR TOTALING ACTUAL PROCESSING OF
CLEANSING PROCESS
PROGRAM_DEFINE( δ );

//DEFINE PROGRAM FOR TOTALING ACTUAL PROCESSING
OF DUST INSPECTION PROCESS
PROGRAM_DEFINE( ε );

//DEFINE "ARRAY DUST[]" IN COMMON DATA STORAGE
REGION
COM_DEFINE(dust[]);
```

FIG. 18

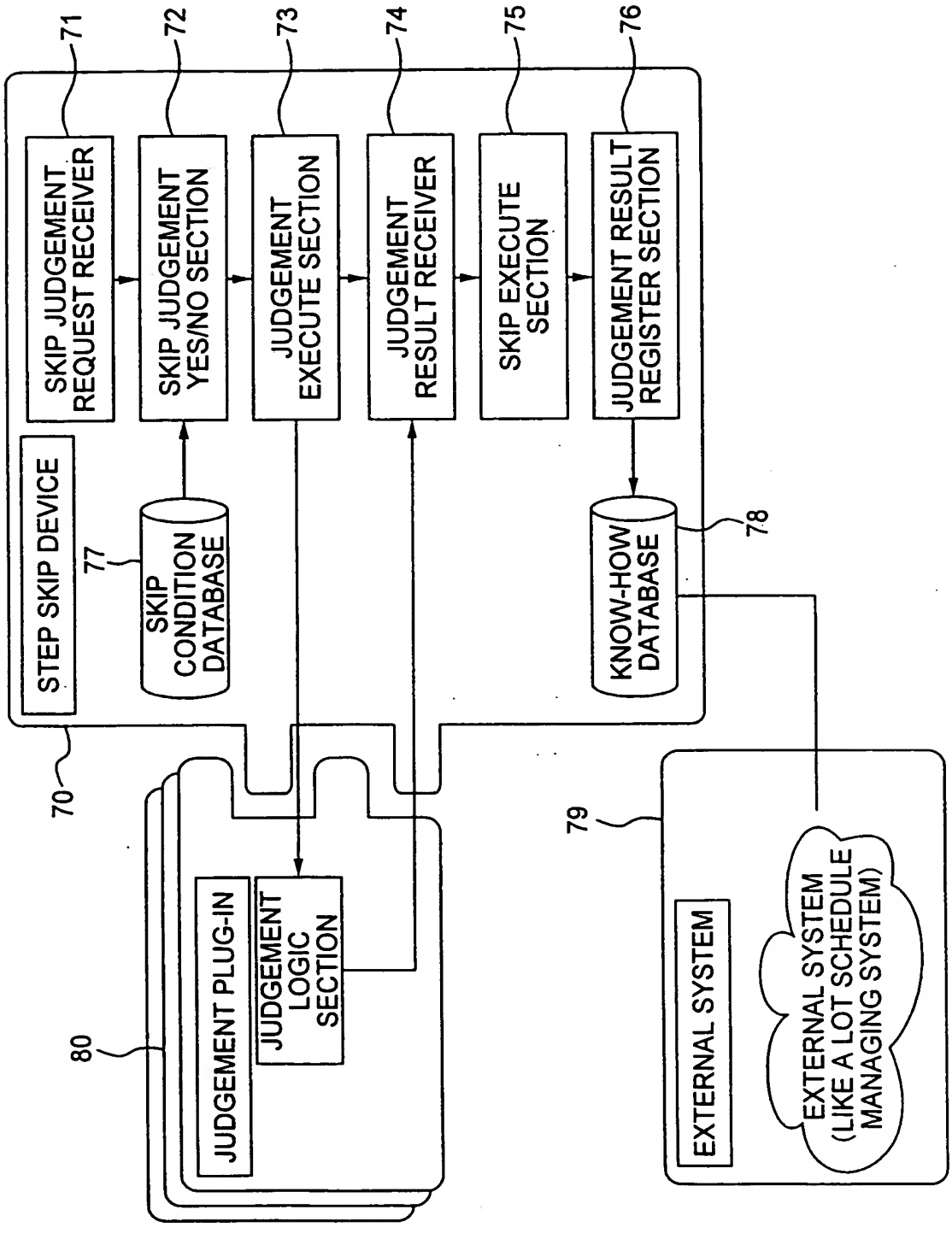

71
72
73
74
75
76
SKIP JUDGEMENT REQUEST RECEIVER
SKIP JUDGEMENT YES/NO SECTION
JUDGEMENT EXECUTE SECTION
JUDGEMENT RESULT RECEIVER
SKIP EXECUTE SECTION
JUDGEMENT RESULT REGISTER SECTION
STEP SKIP DEVICE
77
SKIP CONDITION DATABASE
KNOW-HOW DATABASE
78
70
79
80
JUDGEMENT PLUG-IN
JUDGEMENT LOGIC SECTION
EXTERNAL SYSTEM
EXTERNAL SYSTEM (LIKE A LOT SCHEDULE MANAGING SYSTEM)

FIG. 19

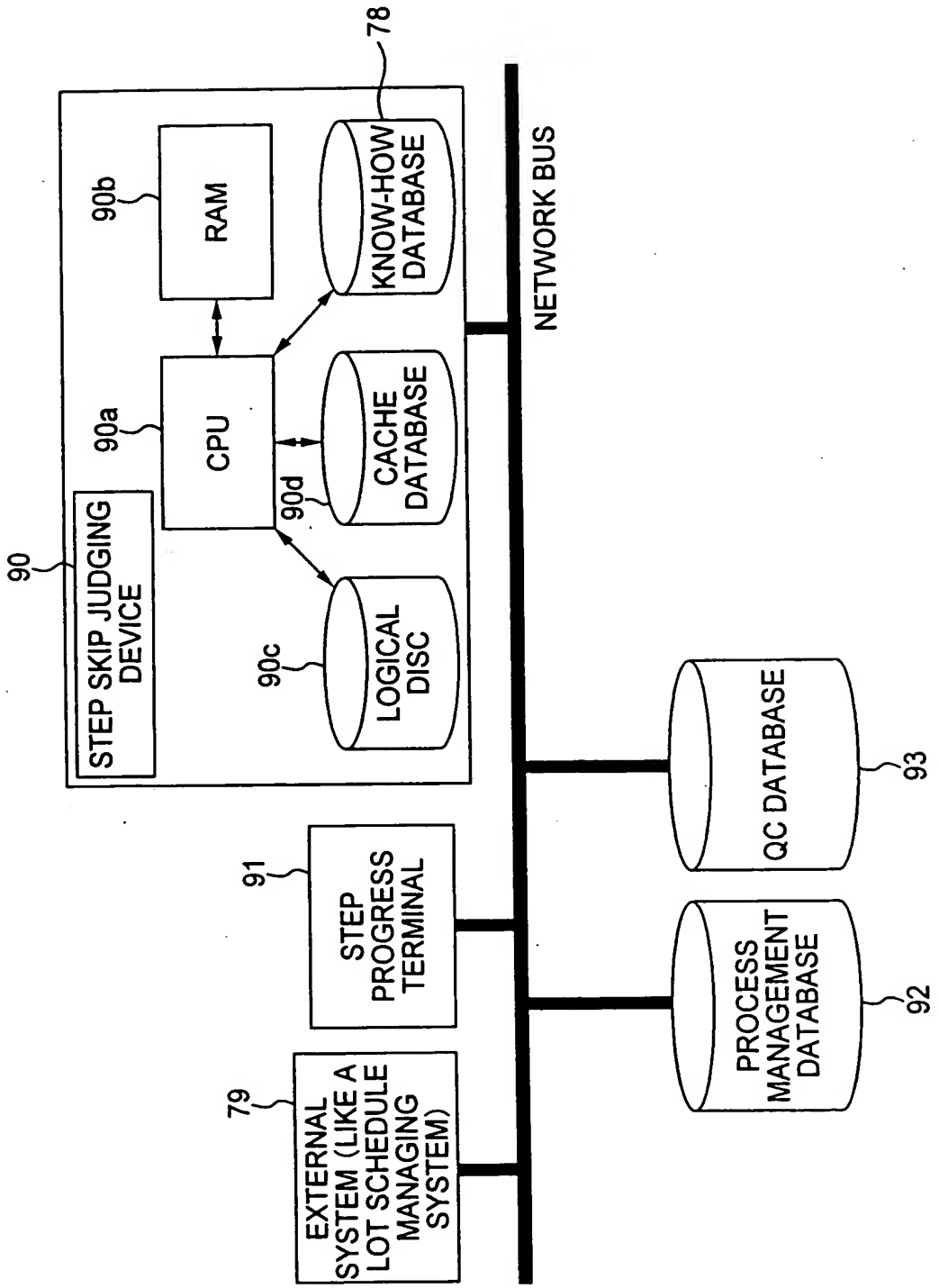

78
90b
RAM
KNOW-HOW DATABASE
NETWORK BUS
90a
CPU
CACHE DATABASE
90d
90
STEP SKIP JUDGING DEVICE
90c
LOGICAL DISC
QC DATABASE
93
91
STEP PROGRESS TERMINAL
PROCESS MANAGEMENT DATABASE
92
79
EXTERNAL SYSTEM (LIKE A LOT SCHEDULE MANAGING SYSTEM)

FIG. 20

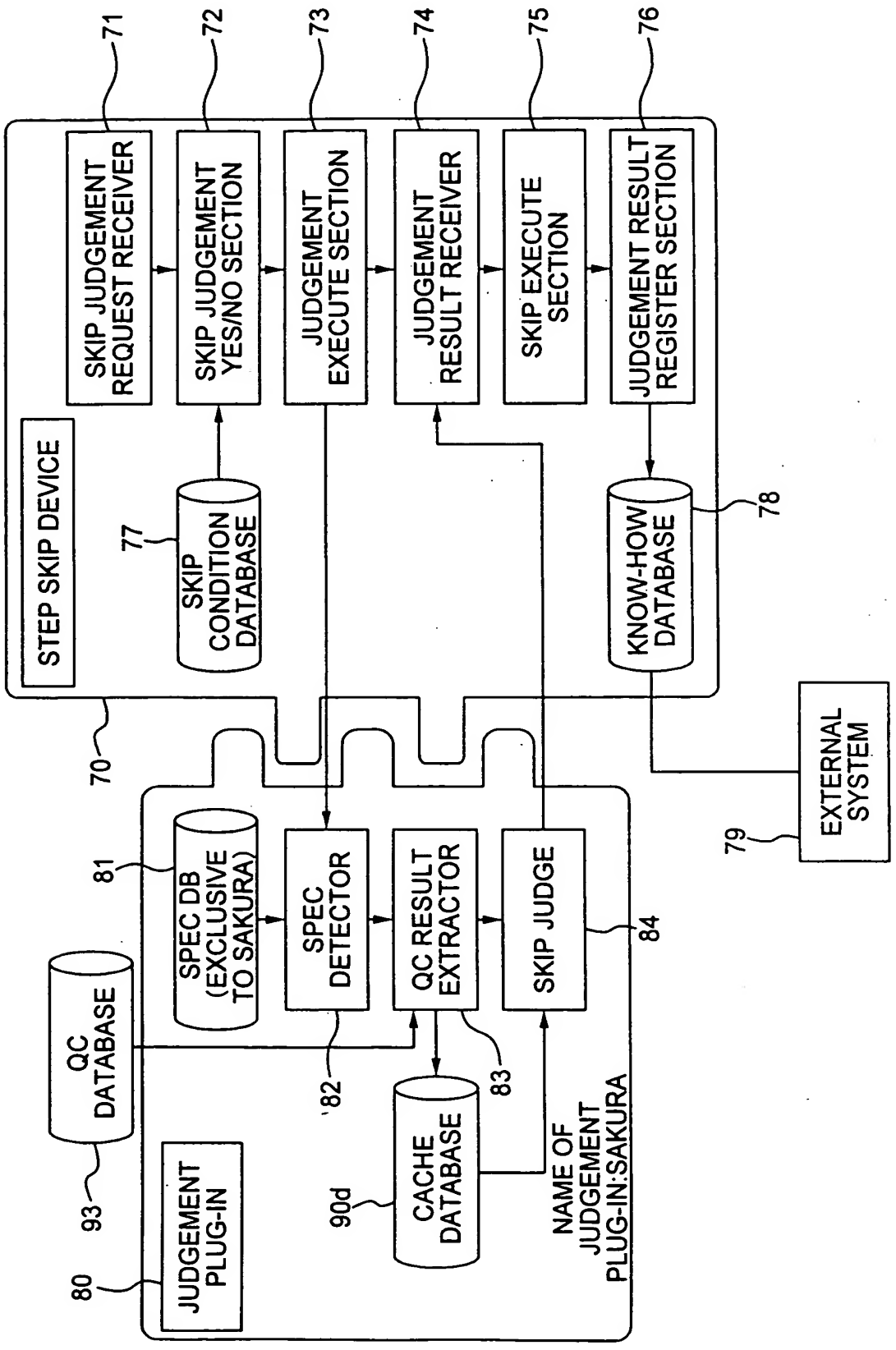

71
72
73
74
75
76
SKIP JUDGEMENT REQUEST RECEIVER
SKIP JUDGEMENT YES/NO SECTION
JUDGEMENT EXECUTE SECTION
JUDGEMENT RESULT RECEIVER
SKIP EXECUTE SECTION
JUDGEMENT RESULT REGISTER SECTION
STEP SKIP DEVICE
77
SKIP CONDITION DATABASE
KNOW-HOW DATABASE
78
70
EXTERNAL SYSTEM
79
81
SPEC DB (EXCLUSIVE TO SAKURA)
SPEC DETECTOR
QC RESULT EXTRACTOR
SKIP JUDGE
84
QC DATABASE
82
83
CACHE DATABASE
90d
NAME OF JUDGEMENT PLUG-IN:SAKURA
93
JUDGEMENT PLUG-IN
80

FIG. 21

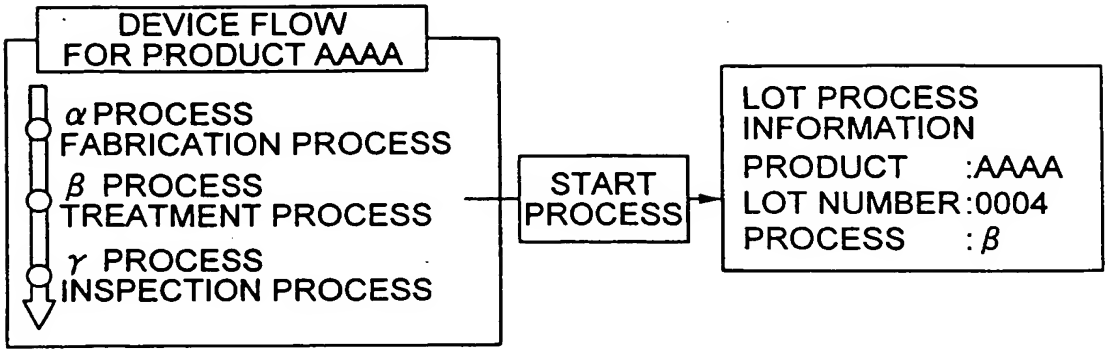


FIG. 22

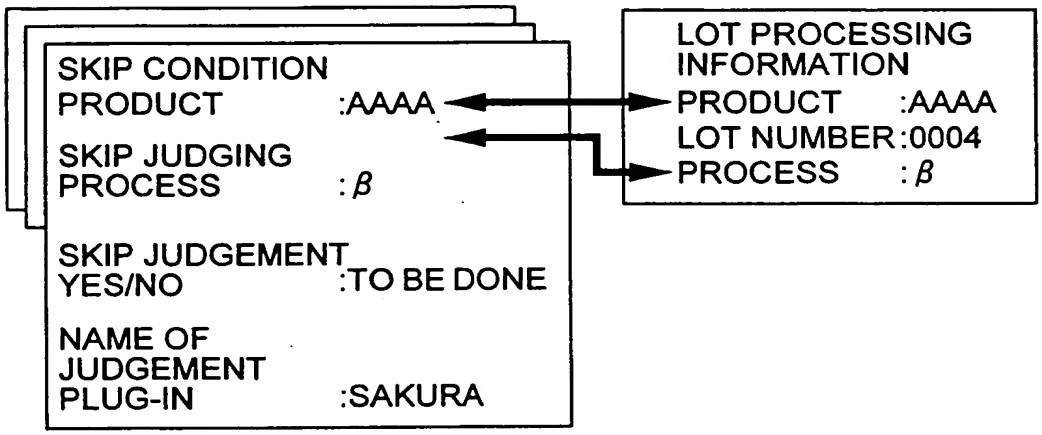


FIG. 23

JUDGEMENT PLUG-IN :SAKURA
INPUT :A=PRODUCT,B=SKIP JUDGING PROCESS
OUTPUT :R=RESULT OF JUDGEMENT
LOGIC :ACQUIRE TYPE OF JUDGEMENT QC STEP C, DATA D TO BE JUDGED, AND SPECS E,F & G FOR PRODUCT A AND SKIP JUDGING PROCESS B FROM SPEC DB EXCLUSIVE TO JUDGEMENT PLUG-IN SAKURA, AND IF F<SPEC D<G FOR E CONSECUTIVE TIMES, SUBSTITUTE "EXECUTE STEP SKIP" FOR R.

FIG. 24

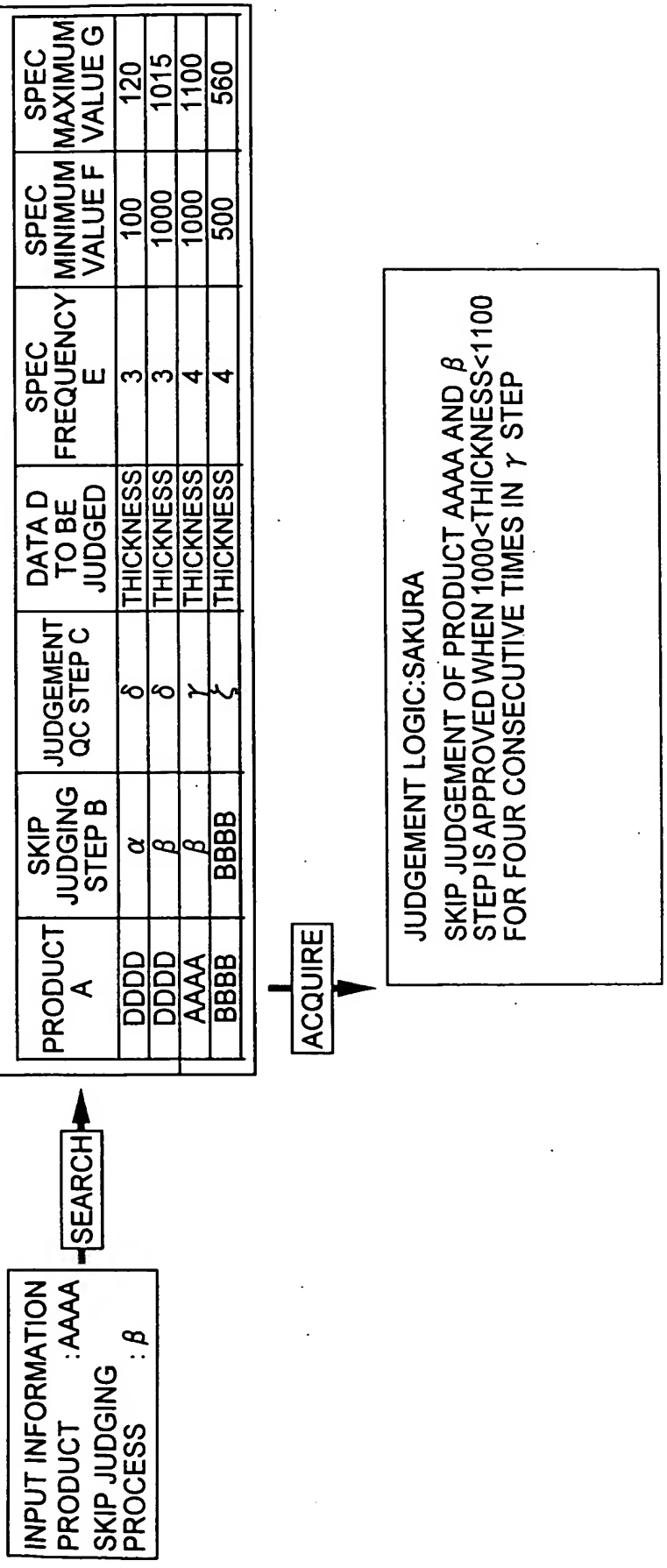

INPUT INFORMATION
PRODUCT :AAAA
SKIP JUDGING PROCESS : β
SEARCH
SPEC D-B
PRODUCT A
SKIP JUDGING STEP B
JUDGEMENT QC STEP C
DATA D TO BE JUDGED
SPEC FREQUENCY E
SPEC MINIMUM VALUE F
SPEC MAXIMUM VALUE G
DDDD α δ THICKNESS 3 100 120
DDDD β δ THICKNESS 3 1000 1015
AAAA β γ THICKNESS 4 1000 1100
BBBB BBBB ζ THICKNESS 4 500 560
ACQUIRE
JUDGEMENT LOGIC:SAKURA
SKIP JUDGEMENT OF PRODUCT AAAA AND β
STEP IS APPROVED WHEN 1000<THICKNESS<1100
FOR FOUR CONSECUTIVE TIMES IN γ STEP

FIG. 25

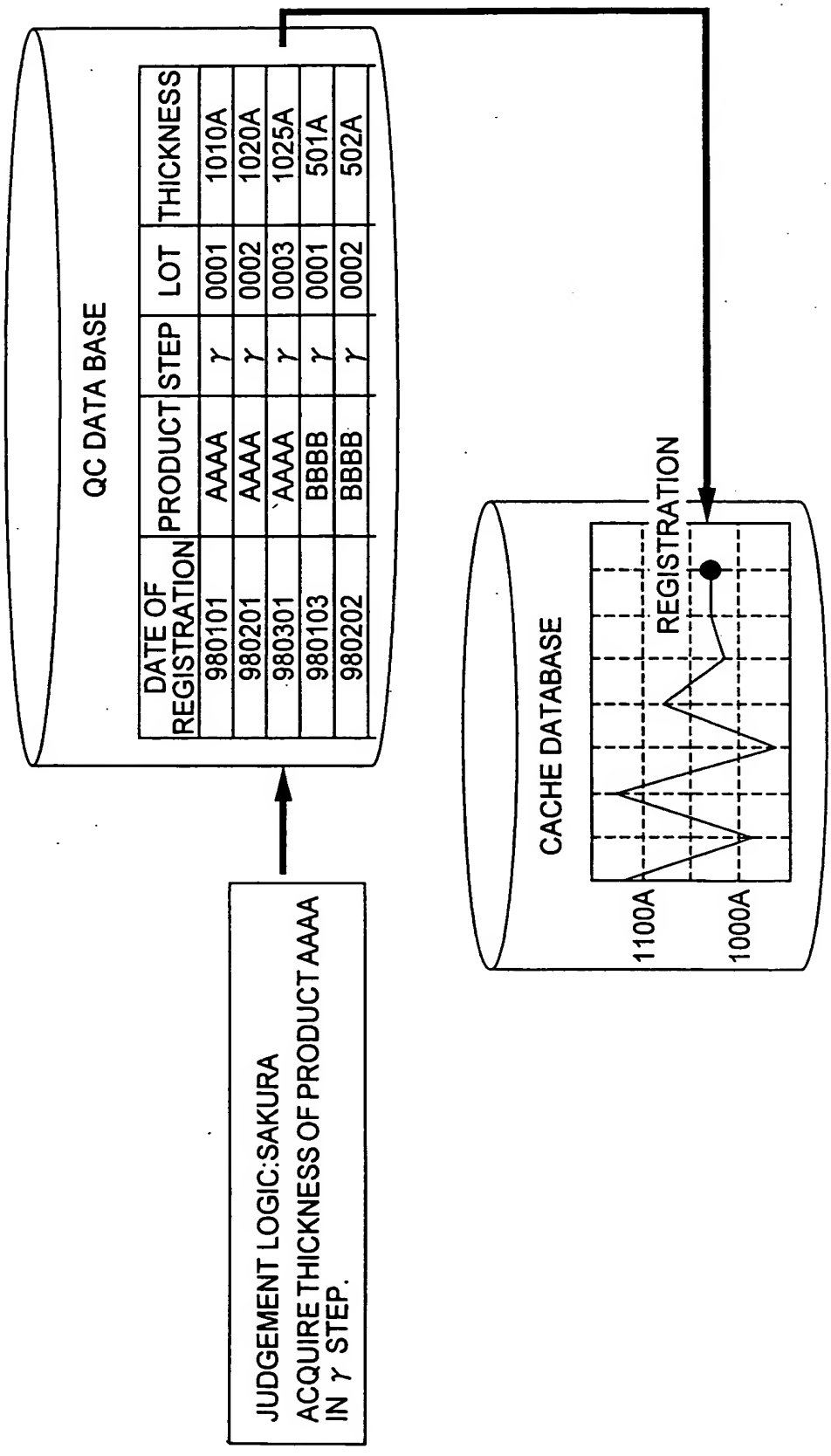

QC DATA BASE
DATE OF REGISTRATION
PRODUCT
STEP
LOT
THICKNESS
980101 AAAA γ 0001 1010A
980201 AAAA γ 0002 1020A
980301 AAAA γ 0003 1025A
980103 BBBB γ 0001 501A
980202 BBBB γ 0002 502A
CACHE DATABASE
REGISTRATION
1100A
1000A
JUDGEMENT LOGIC:SAKURA
ACQUIRE THICKNESS OF PRODUCT AAAA
IN γ STEP.

FIG. 26

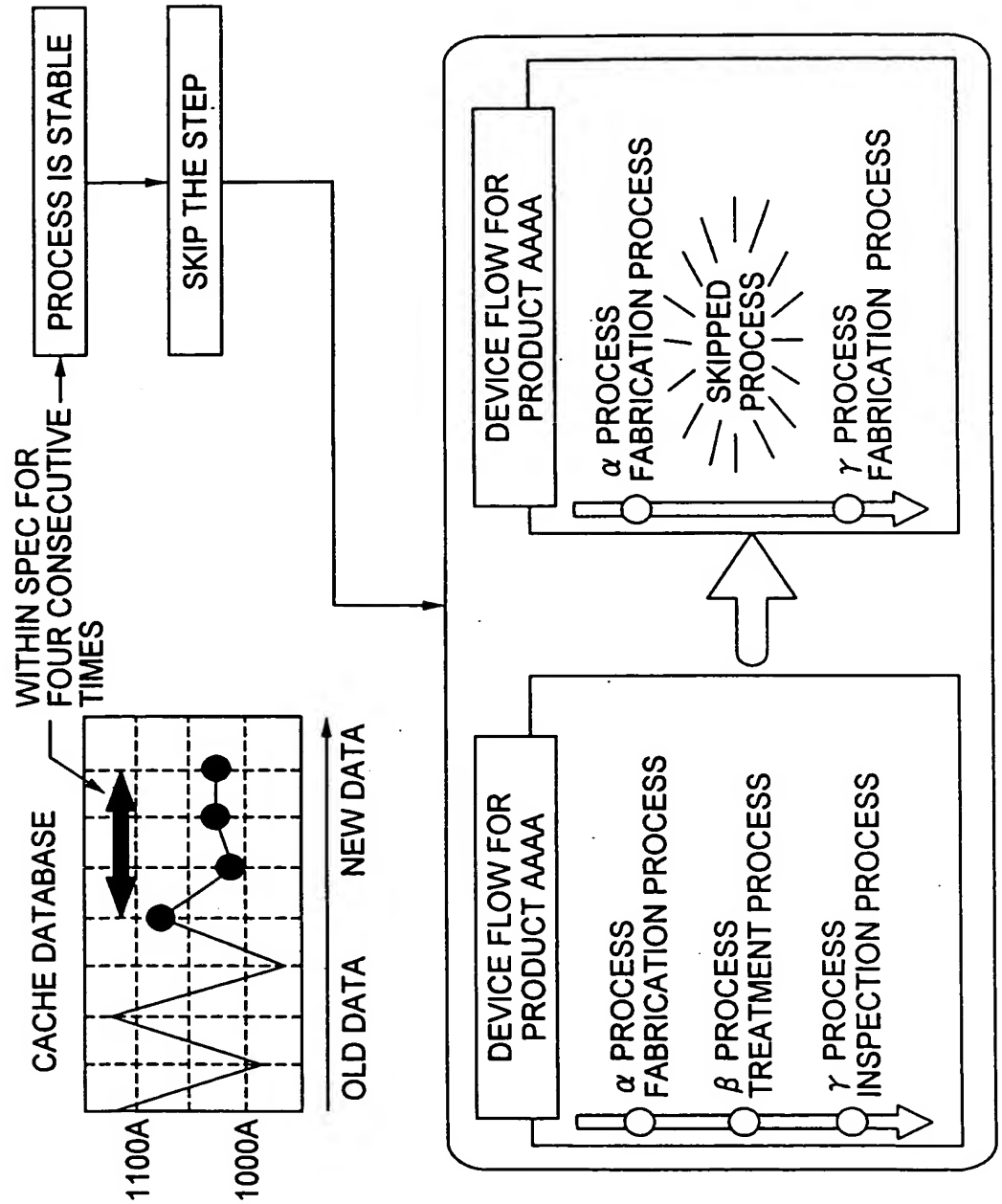

PROCESS IS STABLE
SKIP THE STEP
WITHIN SPEC FOR FOUR CONSECUTIVE TIMES
CACHE DATABASE
OLD DATA
NEW DATA
1100A
1000A
DEVICE FLOW FOR PRODUCT AAAA
α PROCESS FABRICATION PROCESS
β PROCESS TREATMENT PROCESS
γ PROCESS INSPECTION PROCESS
DEVICE FLOW FOR PRODUCT AAAA
α PROCESS FABRICATION PROCESS
SKIPPED PROCESS
γ PROCESS FABRICATION PROCESS

FIG. 27

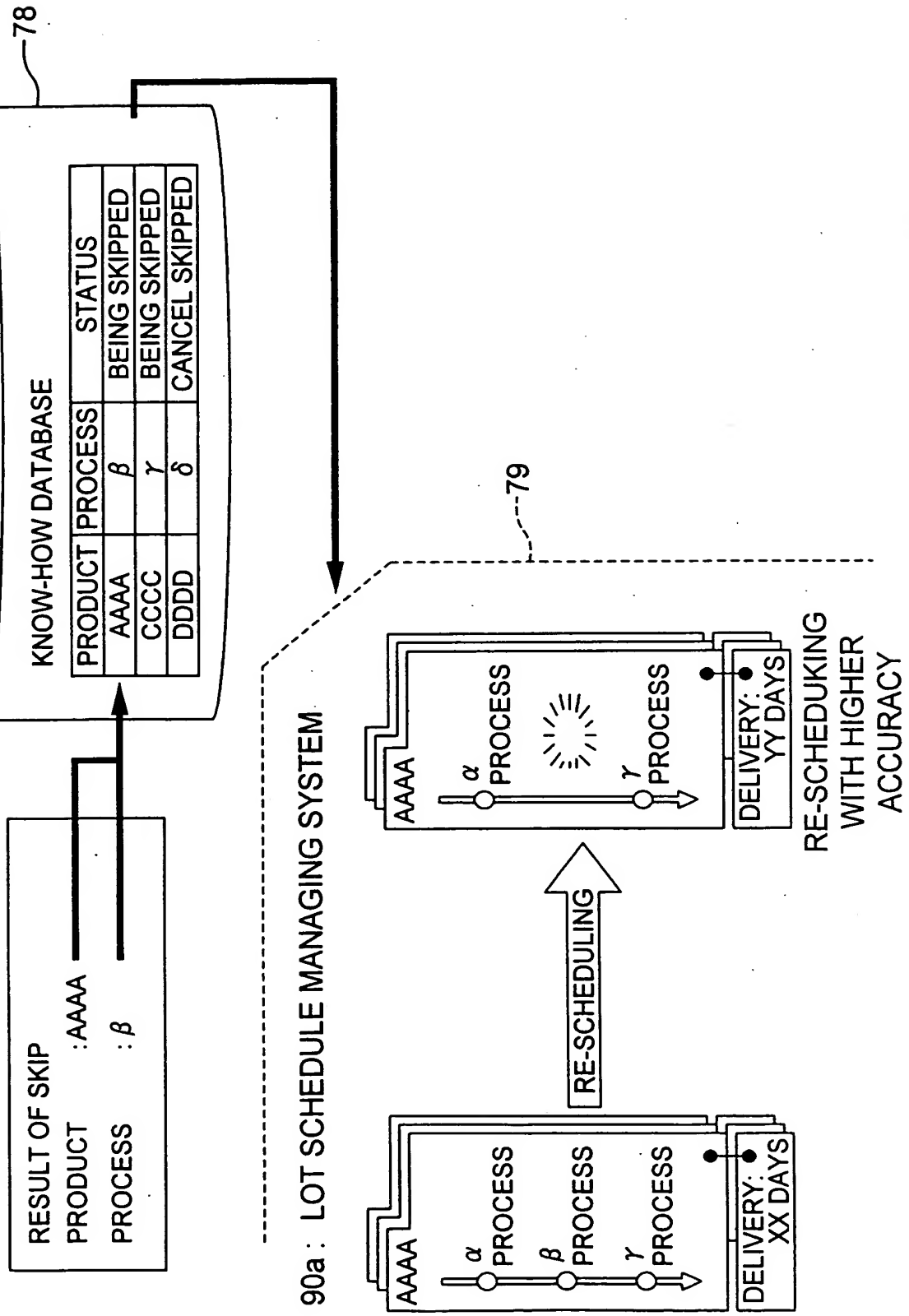

78
KNOW-HOW DATABASE
PRODUCT
PROCESS
STATUS
AAAA
β
BEING SKIPPED
CCCC
γ
BEING SKIPPED
DDDD
δ
CANCEL SKIPPED
RESULT OF SKIP
PRODUCT :AAAA
PROCESS :β
90a : LOT SCHEDULE MANAGING SYSTEM
79
AAAA
α PROCESS
β PROCESS
γ PROCESS
DELIVERY: XX DAYS
RE-SCHEDULING
AAAA
α PROCESS
γ PROCESS
DELIVERY: YY DAYS
RE-SCHEDUKING WITH HIGHER ACCURACY

FIG. 28

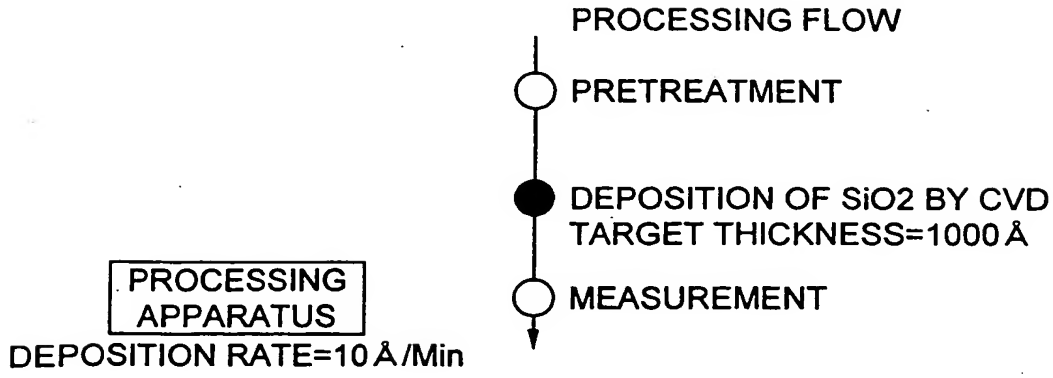


FIG. 29 PRIOR ART

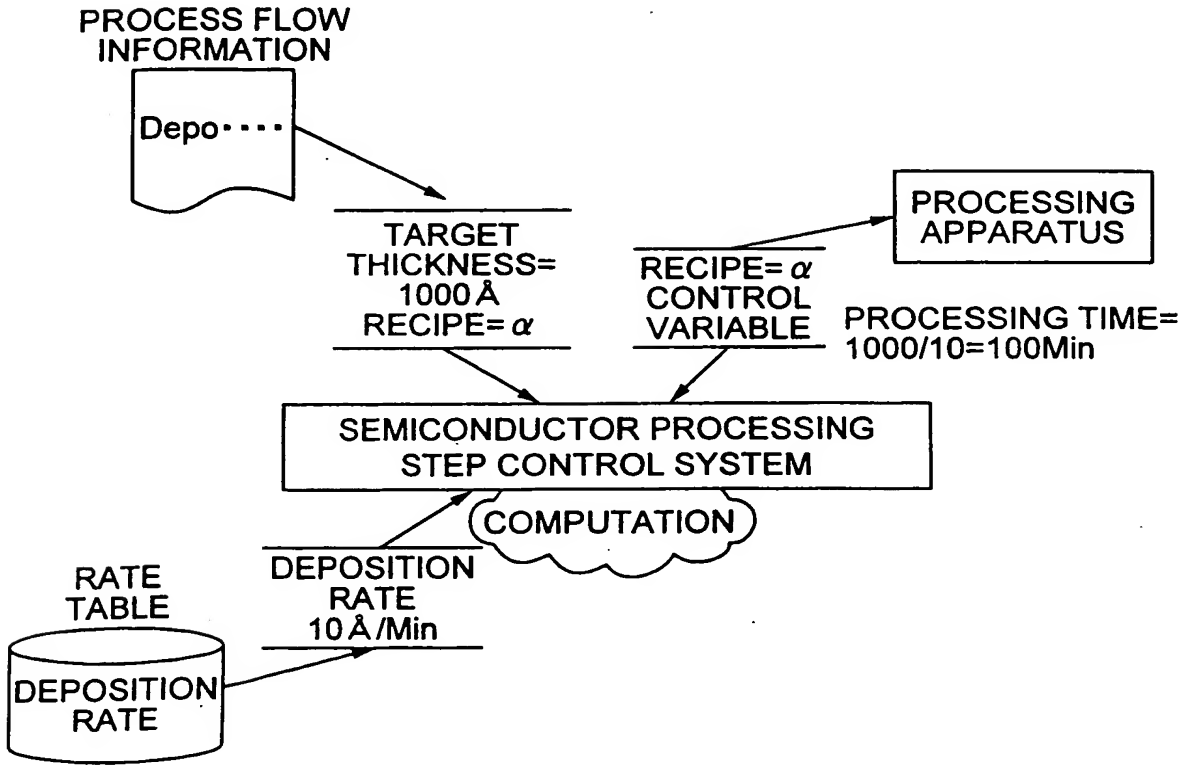
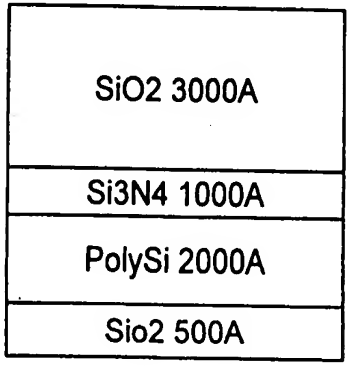


FIG. 30 PRIOR ART

(1) EXAMPLE OF DEPOSITION APPARATUS



PROCESS SPECIFICATION PARAMETER

FILM=SIO2-POLY-SIN-SIO2
THICK=500A-2000A-1000A-3000A
RECIPE=A1

RECIPE MANAGING TABLE (A1)

STEP	1	2	3	4
CONDITION	Depo1	Depo2	Depo3	Depo4

RATE TABLE

CONDITION	Depo1	Depo2	Depo3	Depo4
Rate (A/min)	1234.5	2345.6	3456.7	4567.8

$$\text{Time} = \frac{\text{Thickness}}{\text{DepoRate (Condition)}}$$

CONTROL VARIABLE OUTPUT RESULT

STEP	1	2	3	4
TIME (sec)	500/1234.5*60 =24	2000/2345.6*60 =51	1000/3456.7*60 =17	3000/4567.8*60 =39

FIG. 31 PRIOR ART

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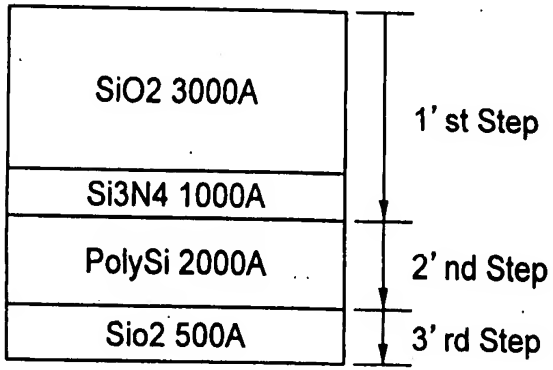
(2) EXAMPLE OF ETCHING APPARATUS



PROCESS SPECIFICATION PARAMETER

STR=SIO2[3000]+SIN[1000]-POLY[2000]-SIO2[500]
TIME=JUST(30%)-50S-JUST(0%)+10S
RECIPE=B1

RECIPE MANAGING TABLE (B1)

STEP	1	2	3
CONDITION	Etg1	Etg2	Etg3

RATE TABLE

CONDITION	Etg1		Etg2	Etg3
FILE MATERIAL	SIO2	SIN	POLY	SIO2
Rate(A/min)	1234.5	2345.6	3456.7	4567.8

$$\text{Time} = \Sigma\left(\frac{\text{Thickness(Film)}}{\text{EtchRte(Film,Condition)}}\right)(1+\text{Over\%})+\text{Abs Times}$$

CONTROL VARIABLE OUTPUT RESULT

STEP	1	2	3
TIME(sec)	(3000/1234.5+1000/2345.6)*1.3*60 =223	DESIGNATED TIME=51	(500/4567.8)*1.0*60+10 =17

FIG. 32 PRIOR ART

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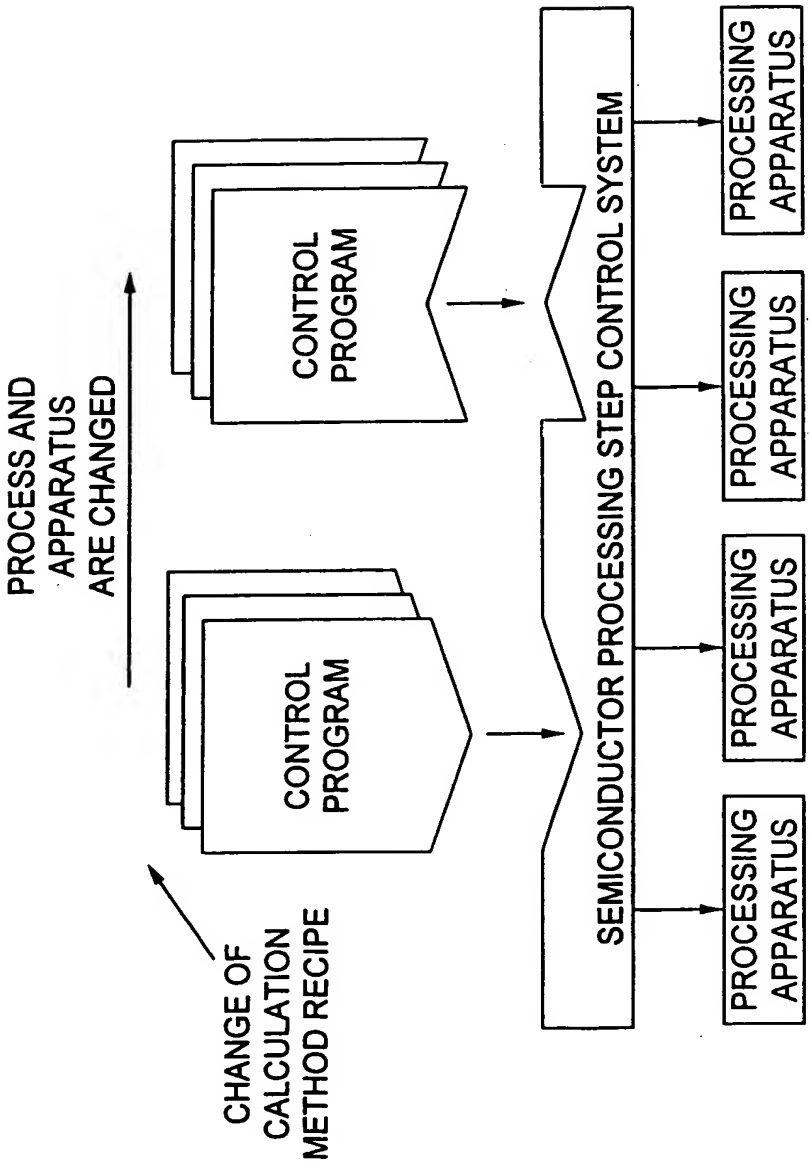

FIG. 33 PRIOR ART